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HARNESSING COMPLEXITY: A FRAMEWORK FOR ANALYZING SCHOOL REFORM

For the past half century, educators have focused on improvement of the perceived weaknesses of our public schools through a number of reform efforts targeting school and classroom factors. In their zeal to improve conditions of learning for 'all students,' schools often adopt more than one innovation simultaneously. The complexity of the innovations, even when considered individually, has made investigation of their impact difficult at best. The differential effects of the unique contexts in which the reforms operate have added to the difficulty. Even less is known about how various innovations interact when implemented together. Therefore, the purpose of this article is to describe an approach to analyzing the interactive effects of multiple reform efforts within a school or school district. The approach resulted from an intensive study of reforms in one district in a state characterized by a strong accountability system. First, we present a brief history of educational reform in general. Then we briefly describe the study that provided the impetus for the approach. Finally, we describe the approach and how it can be applied to facilitate understanding of reform within a school or district.

The Path of Educational Reform

Since 1957, when Sputnik was put in orbit and America determined that something drastic must be done to make its educational system competitive, "reform," "change," and "innovation" have been familiar terms for educators. The National Defense Education Act of 1958 made audio-visual equipment available and provided intensive training to teachers in science, mathematics, and foreign languages. In 1960, Jerome Bruner wrote *The Process of Education*, summarizing the conclusions reached in September, 1959, by a gathering of thirty-five scientists, scholars, and educators at Woods Hole on Cape Cod. Combining insights about the fundamental structure that underlies every academic discipline and the nature of learning, thinking, and motivation, this volume built upon innovative curricula that had been developed (e.g., the work of the Physical Science Study Committee) and laid the foundation for others in the years that followed.

As part of the Great Society legislation that was spawned in the 1960s, Title III of the Elementary and Secondary Education Act of 1965 increased the scope of federal involvement in the reform process by directing funding to the research, development and dissemination of innovation. Legislation and policy in that period were guided by the Research and Development model proposed by David Clark and Egon Guba (Clark & Guba, 1965). However, as

House (1974) pointed out, this model and the policy that flowed from it were essentially linear in nature and failed to take into consideration the separate value systems that guided the research, development, and dissemination processes and effectively ignored the complexities that operated in the adopting school districts.

These complexities were further noted by the Rand Change Agent Study in 1979 (McLaughlin, 1989). The study noted (a) that reform initiatives are shaped primarily by local factors, not by the nature of the innovation, the initiating source, or the level of funding, and (b) that effective implementation is characterized by a process of mutual adaptation. The complexity of the reform process was further exacerbated during the 1970s as federal policy initiatives increased the pressure, state departments were strengthened, and old and new interest groups (e.g., teachers unions and parents) took more active roles (Tye, 1980).

Because of these factors it became apparent that a label used to describe a change does not necessarily mean the same thing to different people. Charters and Jones (1974) commented on the difficulty of measuring the impact of experimental programs in education (and, by implication, any reform) because the independent, manipulable variable (i.e., the reform itself) tends to vary so much in quality and configuration from site to site.

One of the most notable attempts to understand and respond to the complexities of innovation and reform was the Concerns Based Adoption Model (CBAM) developed at the Research and Development Center for Teacher Education at the University of Texas (Hord & Hall, 1984). CBAM examines the change process in terms of its complexities in regard to three dimensions: (a) Stages of Concern, (b) Levels of Use, and (c) Innovation Configuration. The Stages of Concern identify how users perceive and feel about the configuration; Levels of Use speak to what teachers and others are doing or not doing in relation to the innovation or reform; and Innovation Configurations describe the operational forms that the innovation takes.

Educational reform received a boost in 1983 with the publication of *A Nation at Risk* (National Commission on Excellence in Education, 1983). The challenge to educators was couched in terms of national security:

> If an unfriendly foreign power had attempted to impose on America the mediocre educational performance that exists today, we might well have viewed it as an act of war.... We have, in effect, been committing an act of unthinking, unilateral educational disarmament. (p. 5)

These memorable words resonated with federal and state policy makers and, consequently, had a corresponding impact on local educators. The accountability movement was launched, and statewide testing programs were initiated

around the country. Calls for vouchers and charter schools increased in number and volume.

Three years after the report, the National Governors Association began to take an active role in emphasizing the link between educational achievement and the nation's ability to compete economically in the world. In 1989, the governors and President George Bush reached consensus on National Education Goals 2000 with regard to: student readiness for school; graduation rates; school safety; and student competencies to support economic productivity, scientific advancement, and citizenship. America 2000, adopted in 1991, proposed a strategy to implement these goals (United States Department of Education, 1996). Packaged slightly differently and reinforced by a strategy for implementation and tracking progress, these goals were reinforced and extended by the Clinton administration through the Goals 2000: Educate America Act (United States Government Documents, 1994). Recent federal legislation, No Child Left Behind (NCLB), contributes a compelling legal aspect to the highly moral imperatives of providing all students with an adequate opportunity to learn and improving the academic achievement of students most at-risk of academic failure.

A push towards high-stakes testing at the state level has accompanied the NCLB legislation and several states, including Texas, have served as models in this regard. As a result, state accountability systems have become more comprehensive, pervasive, and intrusive. Schools that do not meet standards for student achievement, attendance, and graduation are beginning to face big penalties. High stakes accountability systems are affecting schools in an increasing number of states and their shape and efficacy became major political targets in the presidential election of 2000. Focus on accountability remains a major concern as educators implement strategies to address current federal mandates related to NCLB.

Schools have responded to statewide accountability systems by adopting all types of reform packages imported to deal with various elements of school improvement. These reforms have in some cases been targeted at selected pieces of the school curriculum (e.g., Reading Recovery, Advance Placement Program) or at the overall program (e.g., Accelerated Schools, High Schools That Work). Reform in schools has become a major social and political concern of local school districts. Yet still little is known about how separate reform packages interact with the ongoing educational program, with each other, or with an overarching statewide accountability system. Although the analysis of reform, through strategies such as CBAM, has abandoned the simple linearity of earlier efforts, there is a great deal of complexity, caused by the interactive effects of reform, that still defies comprehensive analysis.

A Recent Attempt to Understand Reform

The authors have recently had the opportunity to address this issue of reform interactivity with the support of a planning grant from the Spencer Foundation. Our work was conducted in an urban school district in Texas with a student population slightly greater than 30,000. Like every other district in Texas, this school district operates under a highly developed state accountability system that *Education Week* has described as "com[ing] the closest to having all the components of a complete accountability system" ("Demanding Results," 1999, p.5). In particular we were looking at the gaps in passing rates on all parts of the state test (TAAS) between ethnic groups (African American, Hispanic, and white Anglo students) as well as gaps between economically disadvantaged students and their more advantaged peers. These gaps have closed significantly within the past five years, but they still exist. Our purpose was to examine how separate reforms, adopted by schools in the district, combine with the ongoing district educational program and the statewide accountability system to impact student achievement and the remaining gap. To do this, we proposed the formation of a collaborative action research team comprised of university and school district participants to focus on identification of district reforms; specification and description of components of reforms identified; and description of achievement patterns of various groups in schools where reforms were implemented.

Our first step was to form a collaborative working relationship between our university researchers and school district personnel. To achieve this we identified a core committee made up of university researchers and campus and district administrators. The Core Committee, initially composed of university researchers, district administrators, and a principal from each school level (elementary, middle, and high school) was revised as we identified additional stakeholders (e.g., Directors of Evaluation and Title I).

As we collaborated, we agreed on several working rules to guide the process: (a) use small working groups to accomplish objectives with extensive feedback from broad-based representative groups; (b) utilize existing district structures for feedback and dissemination whenever possible to avoid duplication of effort for teachers and administrators and to achieve maximum dissemination of our activities and findings; and (c) align planning year goals and activities with district goals and activities to insure compatibility and continuity of efforts. As a result, the Core Committee worked closely with the existing district Curriculum Alignment Committee (CAC) composed of teachers from every school in the district and the Principal's Group composed of school-based administrators. In addition, members of the Campus Advisory Teams (CAT) participated in role-alike focus group interviews. The sections

that follow outline the processes and products associated with activities of the Core Committee.

Using a broad definition of reform we included innovative programs implemented within the past 10 years related to the education of PreK-12 students. These included reforms developed locally or adopted/adapted from national or state programs that either exhibited a school-wide focus or targeted a specific purpose, population, strategy, or content area. Two separate sets of matrices for each school (one for school-wide reforms and one for targeted reforms) generated a list of 74 different reforms in operation in the district (See Appendix A for list of reforms by school level). Matrices with accompanying glossaries were presented to teachers at a regularly scheduled Curriculum Alignment Committee meeting, to principals at their monthly meeting, and to focus group participants during an interview. In each case, participants were asked to add or delete reforms listed for their school, provide an estimate of the length of implementation in their school, and revise elements of each reform according to the form the implementation had taken locally. Numerous changes in the number and type of reforms in schools were made by each group over a period of six months as they determined exactly what was being implemented at various sites.

We also examined achievement data for each school over a five year period, disaggregated by ethnic group and socio-economic status (See Appendix B). Finally, on the basis of the reform matrices and achievement patterns for the separate campuses, we chose teachers and administrators from 16 selected schools for participation in separate administrator and teacher focus groups at each level of schooling. We conducted six role-alike focus group interviews with teachers and administrators from the Campus Advisory Teams of the 16 focus schools (elementary, middle, and high school teachers and elementary, middle, and high school principals) using the protocol included in Appendix C. While all focus schools were invited to participate, not all were represented in the interviews due to scheduling difficulties. Appendix D includes a chart depicting representation in each interview. Interviews lasted approximately 90 minutes and were taped and transcribed for subsequent analysis.

The diverse data attained from these three sources accentuated the complexities that have frustrated reformers for the past four decades. From this complexity four attributes emerged that characterized each reform: commitment, congruence, coherence, and continuity. Each attribute has two dimensions. In addition, we identified three types of impact resulting from the implementation of reform: direct impact, residual impact, and unintended impact.

The 4C Model

The overall relationship between the four reform attributes and the three types of impact is illustrated in Figure 1. We describe the nonlinear, interactive nature of these elements in the final section of this article.
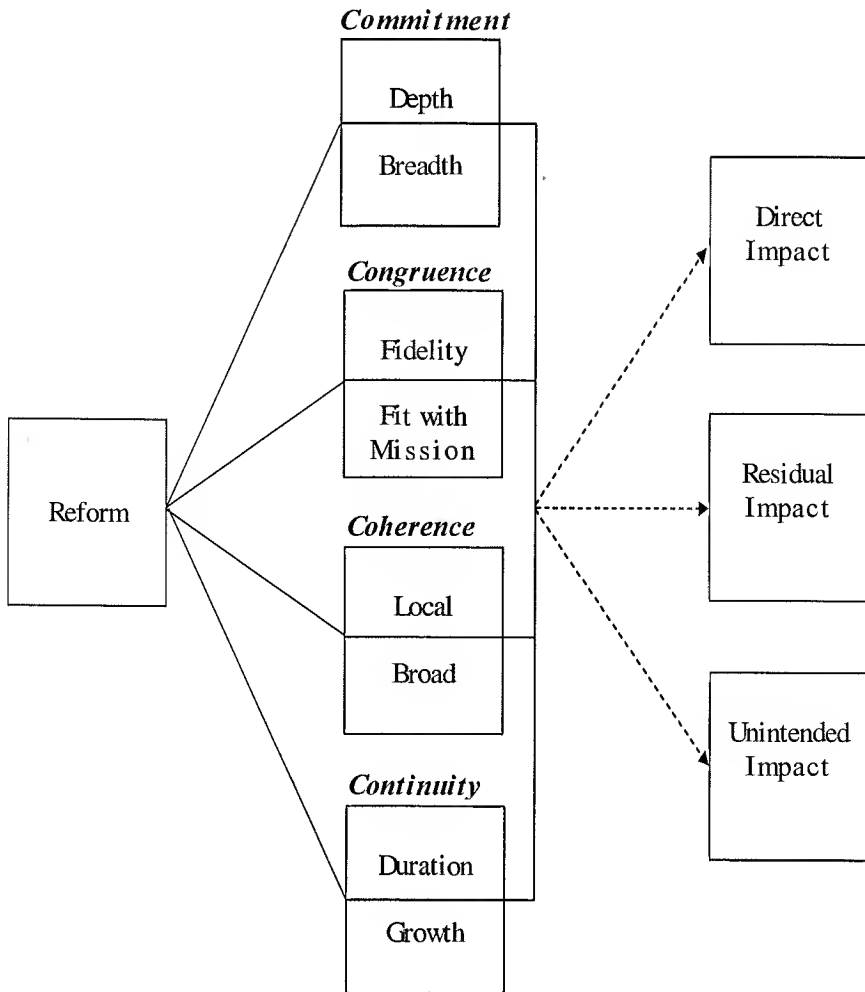

Figure 1: Relationship Between Reform Attributes and Impacts

We have labeled our model for analyzing reform as the 4C Model after the terms it uses to characterize the attributes of reforms: commitment,

congruence, coherence, and continuity. While Figure 1 depicts the relation-ship in a more linear fashion, Figure 2 suggests the interactive relationship of these four attributes. Each attribute is discussed separately in the following sections.
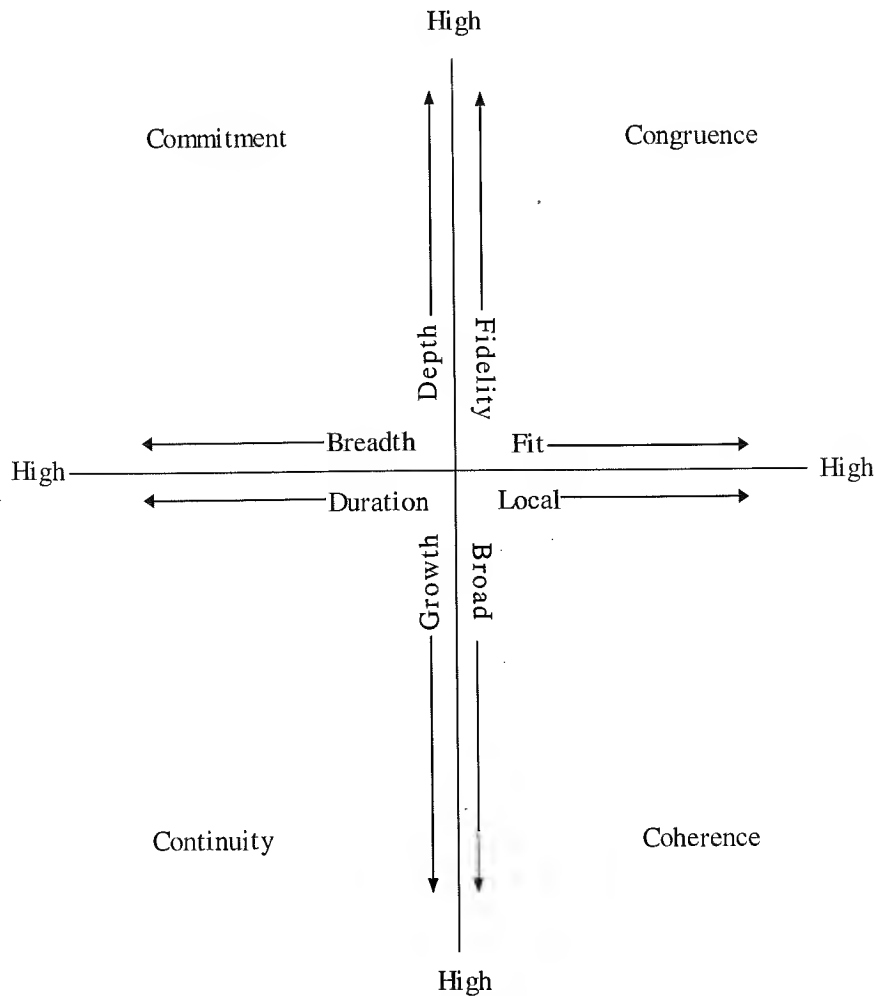

Figure 2: Interactive Model of Reform Attributes

Commitment

Commitment refers to the level of involvement by participants. This can be expressed in terms of *depth* and *breadth*. For *depth*, the question becomes "To what extent is this a priority compared to other commitments?" For *breadth*, we ask "How widespread is the commitment?" or "Are only a few teachers, students, or administrators involved, or is this a school-wide or district-wide effort?" In addition, "What are the criteria (explicit or implicit) for individual or school adoption of a particular reform?" For example, site-based decision-making (SBDM), while it exists in all the district schools we studied, varies in its depth of commitment by campus. Focus group interviews indicated that some see the SBDM committee as only involved in superficial issues or serving in a symbolic, as opposed to functional, capacity. This view of SBDM typically results in reduced or perfunctory participation by members.

Congruence

Congruence denotes the fit between the purpose of reform and the mission of participants. This mission may be the tacit mission of a group of stakeholders concerned about at-risk students or the explicit mission of the school or district to close the achievement gap. Congruence can be expressed in terms of *fidelity* to the original purpose and processes of the reform and in terms of *fit* with the mission of a school or district. A reform may have high fidelity but low fit and the reverse may also be true. For example, several campuses referred to mission statements that suggested that schools should promote a 'lifelong love of learning' among teachers and students. Some teachers feel that this can best be done through whole-language approaches to reading. Therefore, adoption of a phonics-based program such as DISTAR would result in a lack of fit between the mission of the school (as interpreted by teachers from this viewpoint) and the reform.

Coherence

Coherence describes consistency of a reform with other reforms in place and may be categorized as *local* or *broad*. Local refers to within-school consistency and highlights how well reforms work together in a school. Are their goals compatible? Broad refers to consistency with other reforms in the district, not implemented at the site, but which may compete for resources or attention. Do their separate claims on resources (material, equipment, time, and energy) conflict? For example, distance learning at the high school level—

a district technology initiative—was often inconsistent with SBDM. SBDM enabled the four high schools to set their own schedules, resulting in different calendars and class schedules for each school. While the distance courses worked for some campuses, conflicts in schedules made them useless for others. In these cases, distance learning may have a great degree of broad coherence, but low local coherence, when it conflicts with SBDM decisions.

Continuity

Continuity describes persistence of reform over time (number of years) and adaptation of the reform as a result of modifications suggested by data collected on processes or outcomes. We refer to these qualities of continuity as *duration* and *growth*. Data collected for the reform matrices provided information on the duration of reforms in the district. However, focus groups indicate that many reforms remain 'on the books' but do not operate in a meaningful way. Reforms that become part of the 'fabric' of the school typically change in response to changing needs or demographics.

In particular, mobility of both teachers and students impacts continuity, but in different ways. When highly committed teachers retire or change schools, they leave a 'hole' in the expertise related to the reform. Mobility of students creates a different type of threat to continuity of reform. In Texas, one type of student mobility has become synonymous with changes in student demographics (see e.g., Murdock, Hogue, Michael, White, & Pecotte, 1998). Numerous immigrant families have moved into the district in the past five years. Attempts to assess the impact of reform may be complicated by large numbers of students who have had little or no exposure to interventions at the time of assessment.

Impact

The attributes of reform interact in ways that produce certain 'impacts.' Impact can be characterized in three ways:

1. *Direct impact*–implementation of reform results in expected outcomes exhibited by the targets of the reform. For example, students raise TAAS scores as a result of after-school tutoring programs or teachers use a variety of instructional strategies tied to the way students learn after participating in Brain-based Learning workshops.

2. *Residual impact*–reform may not still be actively implemented by the school or district but some elements have been internalized by teachers or principals. For example, the Accelerated Schools Model

may have been abandoned but teachers still engage in inquiry in 'cadres' and book studies.

3. *Unintended impact*—a reform or elements of a reform may or may not have the intended direct impact but may have other consequences that were not anticipated. For example, implementation of a multiple intelligences approach may reduce the focus on drill in basic skills in favor of other artistic, musical, or physical activities. As a result, students' TAAS scores may not show improvement or may even decline.

Embedded within the three types of impact is the possibility of *differential impact*, which suggests that a particular reform might exert a greater or different impact on one group or another. For example, the smaller class size associated with some reforms exerts a greater positive impact on African American students than on white students (Ferguson, 1998).

Application of the 4C Model

The 4C Model has potential applications both to understanding what is happening in school reform efforts and to the construction of strategies that will produce more predictable and potent results. We anticipate that these will happen as we continue to work with the urban school district in which the model was developed. We also believe that the model can have similar applications in other school reform settings.

As the model is applied, it must be kept in mind that the pieces of the model are interactive with both local contextual factors and with each other. For example, we can predict that coherence will have an interactive relationship with continuity. We might hypothesize, for instance, that where coherence is high in both local and broad dimensions, continuity will also be high on both its dimensions. Having formulated this hypothesis we can test it. Similar relationships could be hypothesized for any pair of attributes or for three or all four attributes.

Nor would the hypothesized relationships always be so simple or positive. For example, we may find that "fit with mission" dimension of congruence is a better predictor of continuity than is "fidelity." We may find that "broad" coherence is inversely related to "depth" of commitment.

Similar relationships may be investigated as we look at the relationship between the four attributes and the impacts of reform. We may find that certain combinations of attributes are associated with greater amounts of direct, residual, or unintended impact. And, as we look at impact, we must also be aware of the *differential* impact that may be embedded within each of the other three types.

If we better understand the complexity of reform, it seems logical that we can better plan reform to take these complexities into account. Progress in understanding reform has not been rapid or uniform to this point, and we do not think we will quickly solve the complexity of reform; but we feel the reconceptualization we have introduced in this short paper bears promise of moving us in that direction. The model recognizes the complexity of the reform process and the interactive nature of separate reforms in a more complete manner than has previously been done. It extends the three dimensions of the CBAM model discussed previously by identifying the ingredients of stakeholder concern and involvement and by opening for examination how the configuration of some reforms interacts with the configuration of others. By providing the foundation for a series of testable hypotheses, assumptions of the model can be disconfirmed and therefore, continually refined and improved as the model is applied.

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Appendix A

Whole School and Targeted Reform

Elementary

Whole School	Targeted
Academics 2000	(FRIE) Bil/ESL Continuum
Academics 2000 Ed. Impr. Plan	Accelerated Reader Program
Accelerated School Model	Cognitive Coaching Model
Afterschool Programs	COVEY
Annenberg	Distance Learning Lab
(Houston Annenberg Challenge)	Dual Language
Brain-Based Learning	Education Specialist
Community in Schools (CIS)	Extended Day
Evening Parent Workshops	Guided Reading
Evening Technology Training	Head Start
Help America Read	Heartbeeps
(community involvement)	Integrated Curriculum/
Help America Read (one-on-one)	Thematic Units
Integrated Thematic Units	Library Night
Literacy Groups	Lightspan
Literacy Tutors	Math/Reading &
Mayor's Afterschool Grant	Technology Specialist
Mentors	Multi-age/Looping
Multiple Intelligences	Peer Mediation
SBDM (Site-Based Decision-Making)	Read for America
TAAS Tutoring Groups	Reading Recovery
TRIBES	ROPES
Vertical Alignment Plan	Tutoring
	Workshop Approach
	(Centers w/open-ended tasks)

Middle School

Whole School	*Targeted*
Afterschool Program	20 computers in apartment complex
Block Scheduling	for use by adults with elementary,
CCC Lab (technology)	middle, or high school students
Communities in Schools	4MAT System
CSR-Professional Development	9th Grade Initiative Grant
ESL Continuum	Accelerated Readers' Program
Extended Day Programs-	Advanced Placement Program
Lighted School	Advancement Via Individual
Extended Day Programs-	Determination (AVID)
Project STARR	Algebra Institute
FORMAT Training	BOTVIN
IHE (Increasing	COVEY
Human Effectiveness)	Creating Independence through Stu-
Incentive Program	dent-owned Strategies (CRISS)
Inclusion Project-Region IV	DARE
Integrated Curriculum/-	DAVE
Thematic Units	Distance Learning Lab
Modern Red School House	Ed Tech Grant
Motivational Framework	Education Specialist
Multiple Intelligences	How to Reach the Hard to Teach
Partner Teaching	Literacy Initiative
SBDM (Site-Based Decision Making)	(as part of the CSR grant)
Teaming	Optional Extended Day Program
Technology Integration	(COOL Program)
TRIBES	Perks Referral System
Vertical Alignment	Prejudice Awareness Summit
	Reading Renaissance
	TAAS Prep/Remediation
	Telecommunication Infrastructure
	Funding (TIF)
	World of Difference Diversity
	Training

High School

Whole	*Targeted*
Block Scheduling	20 computers in apartment complex
Cognitive Coaching Model	for use by adults with elementary,
Community in Schools (CIS)	middle, or high school students
Comprehensive School Reform Grant	4MAT System
Distance Learning	9th Grade Initiative Grant
Examining Student Work	Accelerated Reader
Inclusion Committee (SPED)	Advanced Placement Program
Multiple Intelligences	Advancement Via Individual
SBDM Site-Based Decision-Making	Determination (AVID)
School-wide Cadre (Title I)	Algebra Institute
TAAS Committee	Brain-based Learning
TRIBES	Changed science sequence
	COVEY
	Distance Learning Lab
	Drug Knot (Drug Free Schools)
	Ed Tech Grant
	Education Specialist
	English Lab Classes
	Extended time for some math
	classes
	Freshman Foundation
	Library Night
	Literacy Initiative (as part of
	CSR grant)
	Reading - 9th grade
	Reading Renaissance
	SAP Leadership Program
	(mentoring program)
	TAAS Tutors (Prep/Remediation)
	Telecommunication Infrastructure
	Funding (TIF)

Appendix B

District Five Year Gains in TAAS Mastery

School	All students	African Amer.	Hispanic	White	Econom. disadvan.
AREA I					
High School A	+31.5%	+60.6%	+30.0%	+26.7%	+34.3%
Middle School A	+9.6%	+19.8%	+15.1%	- 9.6%	+12.3%
Middle School B	+7.7%	+27.3%	+11.0%	+9.4%	+10.9%
Elementary School A	+20.9%	+23.8%	+24.9%	+16.6%	+22.7%
AREA II					
High School C	+ 8.8%	+43.1%	+25.9 %	+5.8%	+42.5%
Middle School C	+13.6%	+50.0%	+21.3%	+8.7%	+27.5%
Elementary School E	+13.2%	+33.4%	+3.0%	+32.9%	+10.3%
AREA III					
High School D	+ 20.1%	+18.1%	+47.0%	+15.4%	+36.3%
Middle School D	+ 4.3%	+6.3%	+4.2%	+4.5%	+3.6%
Elementary School D	+ 8.9%	+8.3%	+23.6%	+5.0%	+20.3%
AREA IV					
High School B	+ 26.5%	+36.2%	+34.9%	+21.9%	+44.2%
Middle School E	- 2.8%	+13.1%	+2.3%	+2.8%	+6.7%
Middle School F	+ 22.3%	+29.8%	+29.8%	+16.8%	+30.8%
Elementary School B	+ 18.6%	+30.2%	+34.9%	+6.7%	+29.9%
Elementary School F	+ 28.2%	+45.0%	+26.7%	+25.6%	+30.5%
Elementary School C	+ 26.7%	+31.0%	+45.0%	+21.4%	+32.4%

Appendix C

PLANNING GRANT

Focus Group Interview Protocol

I. Background and Purpose

Texas A&M University and your school district recently received a grant from the Spencer Foundation to develop a plan to collaboratively study innovations in schools in the district. As part of our planning year activities, we are attempting to identify and describe innovations or reforms that are currently in place in district schools.

For our investigation, we have broadly defined a reform as an innovative practice or program implemented within the past ten years to achieve a purpose related to the education of students in elementary and secondary schools. These may be reforms that were developed locally or that were adopted or adapted from national or state programs. They may exhibit a school-wide focus or target a specific purpose, population, strategy or content area.

The purpose of the focus group is to obtain your insights about the major issues related to reform in district schools. Our purpose is not to get specific information about your schools but to identify the chief issues of reform so that we can formulate suitable questions for a complete study should we be fortunate enough to obtain Spencer funds to conduct it.

II. Questions

- How can we best identify the persons, offices, and procedures in the school or school district that most influence the way in which an identified reform is selected and implemented?

- How can we most effectively determine how reform initiatives interact with the ongoing school program, with AEIS, and with each other?

- How can we determine if the length of tenure of teachers and principals makes a difference in the implementation of reform?

- How can we determine if student mobility makes a difference in the implementation of reform?

- What kinds of information do you need to answer questions about reform in your schools?

- What would your questions be about reform if you were the researcher?

Appendix D

Focus Group Interview
Participant List

Elementary School Focus Groups

Teacher Focus Group (n=5)   *Administrator Focus Group (n=4)*

Elementary School A   *Elementary School A*
Elementary School C   *Elementary School C*
Elementary School D   *Elementary School E*
Elementary School E   *Elementary School F*
Elementary School F

Middle School Focus Groups

Teacher Focus Group (n=3)   *Administrator Focus Group (n=4)*

Middle School A   *Middle School A*
Middle School E   *Middle School B*
Middle School F   *Middle School E*
                                          Middle School F

High School Focus Groups

Teacher Focus Group (n=3)   *Administrator Focus Group (n=2)*

High School A   *High School A*
High School C   *High School D*
High School D